

~~Method NRK~~  
~~Apparatus and Process For High Speed Data Communication~~  
APPARATUS AND METHOD FOR PARALLEL TRANSMISSION  
OF DATA OVER A TELEPHONE LINE NRK

Field of the Invention

6/29/97

This invention relates to devices for transmitting data over a communications line, and more particularly to an apparatus and a process for transmitting data in parallel over a communications line.

Background of the Invention

Devices for transmitting data over communications lines such as modems are well known in the prior art. These devices are commonly used throughout the world to enable businesses, governments and educational institutions to conduct their affairs. They are also being used more commonly in homes throughout the world for personal computing. The use of these devices continues to increase as ever larger numbers of people are communicating on the information super highway.

Although improvements in modem technology enable the speed at which these devices can operate, the process they employ to transmit data serves as an inherent limitation on the top speed they will ever be able to attain. This is because conventional modems transmit data in serial, i.e. one bit at a time, over one frequency. It is, therefore, an object of this invention to provide an apparatus and a process which overcomes this limitation by simultaneously transmitting multiple bits of data over parallel frequencies.

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### Brief Description of the Drawings

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Referring to FIGS. 3, there is shown ~~a~~<sup>the</sup> drawings<sup>s</sup> depicting how the invention which is the subject of this application operates on bits of data.

Referring to Fig. 1, there is shown a system for high speed parallel transmission of data over a communications line according to the present invention 10. This system is comprised of two identical transmitter-receivers 11 and 21. Transmitter-receiver 11 is comprised of scanner/printer 12, CPU and memory 13, outgoing tone generator 14, mixer 15 multi-line connector 16 and incoming tone discriminators/filters 17.

Transmitter-receiver 21 is comprised of printer/scanner 22, CPU and memory 23, outgoing tone generators 24, mixer/switcher 25, multi-line connector 26 and incoming tone discriminator/filters 27. Device 11 is coupled to device 21 over a communication line such as a standard copper telephone line 30. *Ans. BI*

There is a limit on the amount of data which can be transmitted over conventional communications lines such as copper phone lines using existing technology. The fastest modems are only able to transmit 56.6 thousand bits of data per second. The present invention allows much greater amounts of data to be transmitted by splitting the tone transmitted over a telephone line into multiple tones, and then using pure tones which when combined form a tone which can be filtered, thereby allowing multiple bits of data to be simultaneously transmitted over parallel frequencies.

The present system is designed to transmit data which can be generated or saved in an 8 bit/byte format or any derivative or multiple thereof. Transmission of the data is based on whether a bit is on or off. Detection on the receiving end is based on either the presence or absence of bit specific tones, while all other tones are filtered out and/or ignored. Once converted back to the 8 bit code, the data is saved for viewing or printing.

Referring to Fig. 2, there is shown a flow chart detailing the process by which data is transmitted according to the present invention. To transmit a document 40 using this invention, the document is first scanned

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5

telephone wiring and hardware and will allow for a minimum of 250 Hertz safe zone of separation with generated beat frequencies.

At step 47 the signals from the ten tone generators are combined by the mixer into one multi-tone signal in timed sequence. The mixer overlays the ten tones so that the signal sequence remains <sup>intact</sup> ~~in tact~~ in time, i.e. bits 1 through 10 are transmitted and received at the same time, i.e. they leave in alignment and are received in the same alignment. Specifically, when the first bit of File 1 is transmitted, the first bit of Files 2 through 10 are also simultaneously transmitted. Each bit of the 10 tones equals one beat in time.

At step 48 the multi-tone signal is transmitted over a communications line. At step 49 the signal is received. At step 50 the signal is filtered and then sent to the CPU. At step 51 the signal is reassembled. From there signal can either be stored in memory or sent to a printer or other output device.

Using the aforementioned frequency designations, the following frequencies would be used to transmitted data according to the present invention: 500, 1250, 2000, 2700, 3500, 4250, 5000, 6750, 6500 and 7250 Hertz. Beat frequencies (subtractive) generated would be at 750, 1500, 2250, 3000, 3750, 4500, 5250, 6000 and 6750 Hertz. Beat frequencies (additive) generated would be at 1750, 2500, 3250, 4000, 4750, 5500, 6250 and 7000 Hertz. In the foregoing embodiment, additional harmonics would not be closer than 250 Hertz to main frequency.

In addition, all frequencies generated above 7500 Hertz would be filtered out as they would not be used. The foregoing frequencies are representative only. It is, of course, understood that as filter technology improves, the bandwidths which can be filtered will narrow so that less separation between usable frequencies is required, thereby providing more frequencies on which to transmit data.

By using a selected code, the present invention can be used to encrypt the data being transmitted. This can be accomplished by setting the tone to bit numbering scheme differently for each data transmission sequence even to the point of employing a floating encryption based upon a pre-determined algorithm. This would permit data to be securely transmitted without fear that the person receiving the transmission is not the intended recipient as may happen when a wrong telephone number is dialed. Only the intended recipient would have the encryption key required to read and print the document.

An illustrative example of how data would be transmitted employing the present invention over the aforementioned frequency designations is provided below. Transmission of the word "TEST" using straight corresponding bit-dash tone code would occur as follows:

Beginning code (handshake) sent prior to actual document.

$T = 84 = 01010100 = 6500 + 5000 + 3500 + \text{a parity type check tone} + \text{timing.}$

E = 69 = 01000101 = 6500 + 5750 + 7250 + a parity type check

tone + timing.

S = 83 = 01010011 = 6500 + 5000 + 6500 + a parity type check

tone + timing.

T = 84 = 01010100 = 6500 + 5000 + 3500 + a parity type check

tone + timing.

End of transmission sequence.

In the foregoing example, all four letters would be sent at the same time on four parallel frequencies and would be re-assembled after reception based on the <sup>parity</sup>~~parity~~ check and timing key sent along with the data.

It will be understood that the embodiment described herein is merely exemplary that a person skilled in the art may make many variations and modifications to the described embodiments utilizing functionally equivalent elements to those described. Any variations or modifications to the invention just described are intended to be included within the scope of this invention as defined by the appended claims.

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